PROCEEDINGS

of the Eleventh Annual

WESTERN FOREST INSECT WORK CONFERENCE

Ogden, Utah

March 9-11, 1960

Not for Publication

(For Information of Conference Members Only)

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Denver, Colorado

Members Attending Eleventh Annual Western Forest Insect Work Conference

Left to Right, Front Row: George Downing, Jim Kinghorn, Jerry Knopf, Ron Stark, Dwight Hester, Noel Wygant, Bill Wilford, Roy Shepherd; Row 2: Ken Graham, Warren Benedict, Daniel Dotta, Don Parker, Walt Cole, Amel Landgraf, Don Cahill, Bill Bedard, Malcolm Furniss, Otis Maloy, Ed Clark, Dick Washburn, Paul Grossenbach, Jack Whiteside; Row 3: Ben Howard, Bob Furniss, Philip Johnson, Ralph Hall, Gene Ostmark, Tom Terrell, Pete Orr, Tom Silver, Galen Trostle, Mel McKnight, Chein Chola, Donald Hopkins, Jack Bongberg, Julius Rudinsky, Art Moore, Norman Johnson; Row 4: David Scott, George Hopping, Tom Harris, Clarence DeMars, George Struble, William McCambridge, Don Pierce, Herbert Ruckes; Row 5: Boyd Wickman, Bob Denton, Homer Hartman, John Wear, Bob Lyon, William Coulter, William Klein, Archibald Tunnock, David Evans, Paul Lauterbach, Al Rivas, Frank Yasinski, Calvin Massey.
Not Shown: Ernest Field, William James, Fred Knight, Harold Dodge.

IN MEMORIUM

ED CLARK, ONE OF OUR HIGHLY
RESPECTED AND ACTIVE MEMBERS,
PASSED AWAY ON MAY 23, 1960.

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EXECUTIVE COMMITTEE (Eleventh Conference)

R. W. Stark, Berkeley	-	Chairman
Dr. K. Graham, Vancouver	-	Alternate for Immediate Past Chairman - M. G. Thomson
J. M. Kinghorn, Victoria	-	Secretary-Treasurer
C. L. Massey, Albuquerque	-	Councilor (1957)
E. C. Clark, Moscow	-	Councilor (1958)
G. T. Silver, Victoria	-	Councilor (1959)

D. E. Parker, Ogden	-	
R. I. Washburn, Ogden	-	Program Co-chairmen

EXECUTIVE COMMITTEE ELECT

B. H. Wilford, Fort Collins	-	Chairman
R. W. Stark, Berkeley	-	Immediate Past Chairman
A. E. Landgraf, Denver	-	Secretary-Treasurer
G. T. Silver, Victoria	-	Councilor (1959)
G. R. Struble, Berkeley	-	Councilor (1960)
	-	Councilor (1958)

R. C. Hall	-	Program Chairman
R. W. Stark	-	Program Co-chairman

Prepared by the Secretary-Treasurer, Amel E. Landgraf, Jr., from summaries submitted by the discussion leaders, named under each section. Stenographic assistance was provided through the services of Mrs. A. E. Landgraf, Jr., and by the Division of Timber Management, U. S. Forest Service, Region 2, through the services of Miss Susan Heifner. Duplicating services were contracted.

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ETHICAL PRACTICES COMMITTEE

Jack W. Bongberg, Washington D. C. - Chairman

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INTRODUCTION

THE PROCEEDINGS INCLUDED HEREWITH ARE FOR INFORMATION ONLY. THE MATERIAL INCLUDED IS TO BE CONSIDERED APPROXIMATED SUMMARIES OF PRELIMINARY FINDINGS. THE MATERIAL MAY NOT BE USED IN WHOLE OR IN PART WITHOUT THE PERMISSION OF THE CONTRIBUTOR.

MINUTES OF THE INITIAL BUSINESS MEETING

March 9, 1960

The Chairman, Dr. R. W. Stark, called the meeting to order at 9:10 a.m. in the Ben Lomond Hotel, Ogden, Utah.

Dr. Reed W. Bailey, Director of the Intermountain Forest and Range Experiment Station, welcomed the conferees. He stressed the importance of meetings such as the work conference. In addition he gave an interesting account of the Ogden area from both a geological and economic viewpoint.

The following people, attending the conference for the first time, were introduced:

William James	Bill Klein
Ernest Field	Al Rivas
Otis Maloy	Homer Hartman
John DeMars	Jerry Knopf
Chein Chola	Don Cahill
Mel McKnight	Don Pierce
Dwight Hester	George Knowlton

Mr. Washburn outlined program and other arrangements for the meeting. The banquet and social hour was scheduled for the evening of October 10. Members wishing to display black and white photographs were advised to contact Mr. Knopf.

The Secretary-Treasurer outlined proceedings of the executive committee meeting held March 8, 1960. Council recommendations arising out of the business were:

(1) That the Nominating Committee consist of P. C. Johnson, G. R. Hopping, and N. D. Wygant, with the latter acting as Chairman.

(2) That the term of office of the Secretary-Treasurer be limited to two years (requiring a constitutional change by the general meeting).

(3) That the nominating committee present a slate of officers, including Chairman, Secretary-Treasurer, one three-year Councilor, and a Program Chairman for 1961. Furthermore, it was recommended that the Chairman and Secretary-Treasurer nominees be selected from the same area to improve executive liaison.

(4) That the "central triangle" concept of meeting locations be dropped. Instead, meeting locations should be distributed in such a manner that no one region is consistently required to travel excessive distances.

(5) That the locations of meetings be projected two, rather than one year in advance. Portland was recommended for 1961, and Berkeley for 1962.

(6) That the program theme for 1961 be "The Effect of Insect Damage From Regeneration to The Final Product."

(7) That this year's program committee prepare a brief report of this meeting as a news release for publication in the Journal of Forestry.

(8) That the Secretary-Treasurer be authorized to distribute proceedings of the conference to libraries upon request. An introductory note should be included, stating that the proceedings are approximate summaries of preliminary findings, and that material may not be used or reproduced without the permission of the contributor.

(9) That the lists of current research projects be included in this year's proceedings.

Dr. Hall moved that Article IV, Section (3) of the constitution be amended to read: "A Secretary-Treasurer to act for a period of two meetings, whose duties shall be to keep a record of membership, business transacted by the organization, funds collected and disbursed and to send out notices and reports." Seconded by Dr. Wygant. Carried.

Mr. Washburn stated that an attempt should be made to minimize conflicts of other meetings with the work conference. He noted a growing tendency for supplemental in-service meetings to be held simultaneously with the work conference, to the detriment of the latter.

Upon an inquiry as to the status of the Common Names Committee by Mr. Bongberg, Mr. P. C. Johnson replied that the committee had nothing to report. He wished to hold a meeting with past members of the committee to chart a new course of action. Accordingly, a meeting was scheduled for the noon recess.

On the subject for future meeting locations, Mr. R. L. Furniss commented that it would be premature to hold the next meeting in Portland because by the next year the new Western Forest Biology Laboratory would be finished at Corvallis. He suggested that 1962 would be much more convenient for his staff and would allow delegates to view the new facilities. Accordingly, Mr. Johnson moved, and Dr. Clark seconded a motion that the 1961 meeting be held in Berkeley, and that the 1962 meeting be held in Corvallis. Carried.

The Chairman announced that discussion of other issues would be held over to the final business session.

The meeting was adjourned at 10:00 a.m.

CRITERIA FOR FOREST INSECT CONTROL DECISIONS IN THE UNITED STATES

By W. V. Benedict, Director, Division of Forest Pest Control,
U. S. Forest Service, Washington, D. C.

Your agenda spots some basic problems of vital importance to control personnel.

(1) What constitutes satisfactory insect control?

(2) What benefits result from present practices?

(3) Are they as favorable and long-lasting as we would like them to be?

(4) Can benefits be improved?

If we can focus our attention upon those four questions, we should leave this conference in a better position than when we arrived with respect to where we stand at present, where we need to go, and how to get there.

If I were to appear last on this 3-day conference rather than first, I expect my comments about criteria used for control decisions would take a [illegible] different twist. In discussing that topic, I am going to talk at some length about priorities. Not that I consider priorities a basic factor for deciding control actions, but because they so often must be considered when funds are limited. When this happens as is frequently the case, priorities tend to obscure the really basic criteria for insect control decisions.

I know from comments made to me from numerous sources that many people are confused over what, on the one hand, is the question of whether a particular insect infestation should be combatted at all, and, on the other hand, which project should get the attention and which ones must be left out when there is insufficient money to go around. These are, in fact, two distinct and separate problems. Availability of public financial assistance may well, and often bring priorities conspicuously into the picture. However, priorities have nothing to do with deciding whether there is need for suppression.

An insect infestation should qualify for suppressive action, on either an initial or maintenance project, when it has been clearly shown by biological and economic evaluations that the infestation will seriously damage the forest resource if action is not taken, that effective suppression measures are at hand, and that the values to be protected are sufficient to justify the cost of the suppression effort.

Unlike the objective in handling forest fires, which is to suppress all fires, a decision of what to do about an insect infestation is much more complicated, as all forest entomologists know. Seldom is it possible or desirable to exterminate a native insect although such action might be taken in the case of a newly introducted and potentially dangerous foreign insect. Under present-day conditions in the United States, it is not feasible to combat every outbreak of native insects. Small outbreaks are developing continuously and many of them subside without causing serious economic damage. Decision to suppress must thus be arrived at by evaluating each potentially dangerous situation, and the measures that can be taken to remedy the situation.

Evaluations are of two types, biological and economic. The biological evaluation determines the capacity or potentiality of the pest insect to inflict damage, the trend of the infestation, the status of parasites and predators, a size-up of the forest environment, the ability of the trees to withstand attack, and an estimate of what damage will occur with and without control. The economic evaluation includes an estimate of the value of the forest resource threatened, an estimate of suppression costs compared with anticipated benefits, and an appraisal of the possible damage the insecticide to be used may have upon other forest values. Evaluation of an insect infestation and its threat to forest values then are criteria for deciding a course of action. Priorities also enter the picture on occasion, as I will explain later.

Neither the biological evaluations nor the criteria for determining cost-benefit relationships are precise measuring devices and the element of judgment looms large in formulating opinions. That is one reason why I believe the topics on the agenda of this conference are so timely and important to all of us in insect control.

Improvements in both biological and economic evaluations are sorely needed to better shape the over-all scope of forest insect suppression and the annual finances needed to carry it out. Furthermore, in light of present public concern about pesticides, which might well interfere with their future role as an essential suppression tool, the resource manager wants the most knowledgeable information he can get to support a decision for or against suppression with insecticides.

The project proposal form in current use isn't the best for providing the information needed in our Washington office review. We are working to improve this form. However, all too often we encounter some pretty shaky justification statements, with respect to both entomological considerations and the forest values threatened. These statements, to be worth their salt, must be backed by dependable figures and analyses. Three of the most important figures are: (1) how much damage will each insect cause in a specific situation without suppressive action, (2) how much of that damage can be alleviated by suppressive action at a reasonable cost, and (3) what are the values of the forest resource threatened by an insect outbreak -- timber (including old growth, second growth, and plantations), recreation, aesthetic, watershed, any one of these or all of them.

Sound answers to these questions aren't easy to get. However, improvement upon what is currently being done is essential if we are to put pest control on a really solid foundation.

Where will improvements in such figures come? Look at your agenda. There you will see the answer. Improvements are going to come from you men assembled here, from research entomologists, pest control personnel, and resource managers whose official responsibilities carry them head-on into the criteria that influence suppression decision. To be sure, the forest economist will get into the act, and already we are working to involve him. But bear this in mind: All the forest economist can do is put together the basic figures given him--given him by the specialists, given him by you. It is no easy task we have and it will test the metal of all who tackle the problem.

I'd like to take a minute or two now to comment about the role of the Washington office on this evaluation business. The evaluations I've just mentioned are made in the field, not in Washington. Project proposals involving Federal financing are prepared by field units, and reviewed by the region. Only after they have regional endorsement and station comments about the entomological situation are they forwarded to Washington for approval and allocation of funds. In this connection, it will interest you to know that, except for small continuing allotments to the regions for general administrative needs and to provide a cushion of cash for quick action on unforeseen new outbreaks, all proposals to suppress pest outbreaks are financed from the pest control contingent in Washington.

In considering whether or not to allot Forest Pest Control Act funds, the Washington office recognizes its responsibility and obligation to see that all proposals have been carefully prepared with due regard to biological and economic factors. If we believe that evaluations made by the submitting unit represent a fair and reasonable picture of the pest situation and need for suppression, values in jeopardy, probable losses, anticipated benefits; that estimates of needs are proper, and that the project otherwise qualifies for Forest Pest Act financing, as for example, assurance that non-Federal financing in cooperative projects is available, we approve the project. From then on, we believe we have a responsibility to try to get the project financed. In other words, if suppression is needed, it should be done, entirely aside from comparative need of one project alongside that of another. This should be the basic premise on which pest control is founded. It is the only way we can get on top of the pest control job.

So much for what should be done. Of course, when there isn't enough money to go around, priorities must play their part. The $64 question then becomes -- which projects get the money and which ones don't? That is not a simple question to resolve.

In weighing the needs of one project alongside another, we have not been able to arrive at any cut and dried formula applicable across the board. It does not seem to be feasible to apply one prescription to all situations. As we see it, each pest outbreak must be evaluated in its own setting and on its own merits, and fitted into the over-all financial picture as best it can. Here are the guidelines we follow. They fall under two main headings: (1) value of the resource threatened and (2) the urgency of suppressive action as determined by the pest hazard.

Value of resource threatened. This falls into four groupings: (1) commercial timber, including second growth and plantations, (2) recreation, (3) aesthetic, and (4) watershed. I'll talk a bit about each.

Factors Evaluated

(a) Stumpage -- its value, accessibility, and intensity of sales activity -- or potential value, if immature

	(b) Value of manufactured products
(1) Commercial timber values	(c) Extensiveness of wood-using industry dependent upon the affected timber
	(d) Community interest in and dependence on affected timber
	(e) Investments in plantations
	(a) Intensity of recreational use -- as measured by visitations
(2) Recreational values	(b) Volume of recreational business as measured by tourist establishments and sales.
	(c) Importance attached to the area by the community, region, and nation
	(a) Local, community, and national interest
(3) Aesthetic values	(b) Threat of a pest outbreak to other stands
	(c) The seriousness of the fire hazard created by a pest outbreak
	(a) Impact of the pest damage itself
(4) Watershed values	(b) Hazard from increased fire hazard resulting from widespread pest damage

I believe you can see some of the problems one can get into in weighing and comparing values in the foregoing four categories. Let's examine a few combinations that make a suppression decision difficult:

Values in recreational areas alongside values in timber areas.

Values on S&P lands alongside those on NF lands, or those on NP lands.

Values in one region or state alongside values in neighboring regions or states.

Values on plantations vs. values on second growth or values on old growth.

Another aspect of the problem relates to our sister agencies in the Department of the Interior. We are responsible to see that their needs for insect suppression are taken care of, and yet, we are in an awkward position to evaluate the importance of their forest resources, alongside those of the national forests or State and private lands.

Generally, important timber values with established industry or forest tracts of high recreational use receive the greatest consideration on the premise that the greater the value, the more important the need for protection. Inaccessible tracts get lower priority consideration than the same quality timber that is currently operable. Reserved stands with little recreational use, such as some wilderness areas, occupy the low spot of the group; in fact, in this category authorization to do control is very restrictive.

Urgency of action as determined by the pest. This factor is largely self-explanatory. The more aggressive, virulent and fast acting the pest, the more urgent the need for suppression. In this category we consider the following factors:

(1) Highest priority is given to a new and potentially dangerous introduced pest in an effort to eradicate or contain it before it becomes firmly entrenched and widespread.

(2) Quick-killing insects, such as bark beetles, get higher priority than the slower acting insects, such as some leaf-feeding insects, spruce budworm, for example.

(3) We encourage prompt action on new outbreaks, even when at times it becomes necessary to trim some financial fat off existing large projects, under the objective of attacking outbreaks as soon as need for suppression has been established to keep the job as small as possible. Here again, the more serious the potential hazard, the higher the priority.

Add the factors that constitute urgency of suppression to those that make up forest values and the job of deciding which projects get the money and which ones don't begins to get complicated. But even those two factors do not represent the whole priority story -- there is still another, the factor of budgets and allotments.

As you know, our Federal budgetary process begins approximately two years in advance of the expenditure period. Because of their unpredictable upsurges and frequent fluctuations, outbreaks of insects cannot be accurately forecast that far in advance. In fact, year-long needs are not always firmly established at the start of the fiscal year and sometimes remain in doubt until near the end.

Because of uncertainty as to the exact dimensions of the pest job in any given year, the regular forest-pest budget is prepared from the best estimates of known needs that can be made ahead of time. When this sum is inadequate, consideration is given to securing supplementals -- to finance projects that expand beyond original estimates, or for new projects that develop after original estimates are prepared. Supplemental funds are recognized by the Department of Agriculture and the Bureau of the Budget as an acceptable way to meet the financial needs of forest pests -- in fact, the Budget people prefer it that way and we haven't made much progress in changing their opinion.

In view of the foregoing situation, we are hardly in a position to hold back substantial funds at the start of the fiscal year to provide for the uncertain needs that may develop later. To hold back too tightly, reserving for a later, greater need that might not materialize, will penalize known projects. For this reason we honor requests as they come along. We thus do not always have the opportunity to weigh the merits of one project against others, especially during the first part of the fiscal year. Under prevailing techniques for predicting suppression needs and for developing the pest budget, I can't see much chance of doing so for some time.

I have gone into some detail to discuss priorities for I think they need to be understood and not confused with the more fundamental issue that action to suppress an insect outbreak should be based on need -- need as determined by hazard-cost-benefit evaluations. Nonetheless, priorities will probably always play some part in the appropriation process of cutting the cloth to fit the pattern, as availability of funds certainly is one of the criteria for insect control decisions. When there is any question about a desired course of action, representatives of affected agencies gather around the conference table and decide jointly the action to take.

I hope what I have said will focus attention on the important part we all must play in improving our position for deciding for a specific situation. Is control necessary?

REVIEW OF CURRENT FOREST INSECT CONDITIONS

IN THE WESTERN UNITED STATES AND CANADA

March 9, 10:45 - 11:30 a.m. Jerry E. Knopf

I. DEFINITIONS AND SCOPE OF PROGRAM

March 9, 11:30 - 12:00 D. E. Parker

II. WHAT CONSTITUTES SATISFACTORY CONTROL?

March 9, 1:30 - 3:00 Paul Lauterbach
Bill James
Jim Kinghorn

Summary (Lauterbach)

1. In any insect control project we would expect the cost of the control to return as much, and preferably more, than was spent. This return would be in the form of reduced timber mortality or damage and loss in value by tree killing or deterioration.

2. We have and will participate in the future in chemical control of defoliating insects when recommended by entomologists as being necessary to restore normal balance between forest and insect populations. However, we do not feel at the present time we should utilize chemicals or other direct control procedures for supression of bark beetle outbreaks.

3. In both the Douglas fir and ponderosa pine regions bark beetles are our most damaging insects. In the Douglas fir region we feel money for insect control can be best spent by constructing logging roads to make all timber accessible. This advanced logging road construction, plus intensive ground and aerial surveys to locate windthrow or other favorable brood material, with prompt logging before insect broods can build up to epidemic populations, is our most feasible method of control. Also, roads present a method of rapidly salvaging killed timber before deterioration losses are serious. In addition, by timber vigor classification of all stands we schedule logging into highest priority stands (lowest vigor, highest accessibility to insect attack) as fast as possible.

4. In the ponderosa pine region at Klamath Falls we utilize sanitation salvage of high risk and newly attacked trees as the indirect method of control. With intensive aerial and ground surveys, trends in tree killing are noted and sanitation salvage is initiated where deemed advisable. On these stands newly killed trees as well as the high risk trees are logged. We are also expanding our logging road construction to make all of our timber accessible to roads. Immediate salvage of windthrow and fire killed

timber is also undertaken in our pine region at Klamath Falls.

In an answer to a question from the floor, Lauterbach stated that Weyerhaeuser's objective of forest insect control in old growth stands was to prevent catastrophic losses and to at least maintain present stand volume and value.

III. BIOLOGICAL EVALUATION REQUIRED ON REACHING CONTROL DECISIONS

March 9, 3:15 - 5:00 — Discussion Leader: Jack Bongberg
March 10, 8:30 - 9:45 — Aided by: Dick Washburn, Tom Silver, Ron Stark

J. W. Bongberg opened the discussion by stressing the need for evaluating the current and potential significance of any given insect infestation before intelligent decision can be made for or against action programs in suppression. The biological and environmental factors that regulate the abundance of insect populations and thus govern their potential destructiveness were briefly reviewed. The ones mentioned as being most important, or at least most obvious, were parasites, disease organisms, climate, weather, host density, tree susceptibility, and stand hazard. Before decision is made for or against the initiation or continuation of suppression, the over-all effects of one or more or all of these factors regulating population densities should be evaluated.

Mr. Bongberg called attention to Dr. Glen's 1954 article in the Journal of Economic Entomology about factors that affect insect abundance and reviewed the salient points in the publication to set the stage for topic discussion on (1) present biological evaluation procedures, by Mr. R. I. Washburn; (2) reliability of present evaluations, by Dr. G. T. Silver; and (3) methods to improve biological evaluations, by Dr. Ronald Stark. In brief, Bongberg quoted Dr. Glen as follows: "The density of an insect population at any given time is a product of the interactions of all concurrently active factors, each of which differs in time and space in its effectiveness. Fluctuations in insect abundance thus arise from different causes and tend to be irregular in their occurrence, thus it is extremely difficult to appraise the individual significance of factors that never act independently."

Current biological evaluation procedures used in reaching control decisions were discussed by R. I. Washburn. Mr. Washburn emphasized the urgent nature of biological evaluations used as criteria for control decision.

He defined biological evaluation as the process of collecting and analysis of factors, both biological and physical, that are exerting an influence on the present population of the pest, and an interpretation of the factors in light of predicting future course or trend of the population. He felt that an evaluation could be accomplished with one observation but more often repeated visits to the area were necessary. Often considerable laboratory rearing and dissection is required to provide the answer.

He further stated that he believed biological evaluations, as such, were both through necessity, because neither research nor appraisal surveys were providing the desired biological information required in reaching control decision. It was his opinion that present evaluation procedures could be divided into two procedure categories - mechanical measurement, and empirical observation. Usually, they are used in conjunction with each other.

He then discussed problems of simultaneous sampling of insect populations. He pointed to the difficulties in evaluating the biological significance of bark beetle infestations and stressed the urgent need for an accumulation of biological data on each of the major pest insects so as to provide opportunity to use indicator techniques in evaluations, such as the single factor analysis described by Morris.

Washburn also stressed the importance of only well-trained forest entomologists making biological evaluations. He emphasized this by pointing out that such things as rapid buildup of diseases, late larval parasitism, or the occurrence of adverse weather conditions can overrule a prediction based on measurements of eggs or early brood.

He then called on Fred Knight who briefly described a method of predicting Black Hills beetle trend by using a sequential plan utilizing samples taken during early July, just before beetle flight began.

G. T. Silver discussed the reliability of present evaluations in reaching control decisions by pointing up the difficulty in evaluating all of the possible factors affecting the insect populations and the host tree, and of assessing the reliability of all the methods used to measure these factors. Dr. Silver's discussion centered upon reliability of evaluating the biological significance of defoliators. He divided methods of evaluation into two catefories, viz.: (1) estimate of the

insect population and trends, and (2) estimate or measurement of extent and intensity of damage to host trees.

It was pointed out by Dr. Silver that all stages of defoliating insects lend themselves to sampling techniques and that each stage is in itself a comparative estimate of the population. The egg state, in the opinion of Dr. Silver, represents the greatest number of relative population stability, thus egg sampling is one of the best means of evaluating populations and trends. Examples were given of egg surveys for black-headed budworm and spruce budworm and of the reliability of information in deciding for or against suppression.

Larval sampling, or tabulating larval density in terms of food supply, was pointed out as also being quite reliable in evaluating populations and trends. Several methods used for sampling larval populations were described. In Canadian experience, beating samples have proved reliable for depicting population trends despite the lack of preciseness of sampling accuracy. The sampling of larval populations at high levels was discussed and complicating factors affecting the degree of their reliability was explained. Dr. Silver stressed the need for precise information on biology and habits of larval stages for accurate and reliable larval sampling. He cited cases where lack of knowledge on larval habits resulted in misleading information from sample data. The added advantages in larval sampling, such as measurements of degree of parasitism, and discory of occurrences of disease organisms in populations, improve the reliability of evaluations.

Pupae of most defoliators are easily collected, thus are useful and oftentimes reliable in biological evaluations. Examples were cited of sampling for pupae and explanations were made of the degree of reliability to be placed on sample data. Adults of defoliating insects also can be used in biological evaluations. However, it was stressed that much additional research is needed before adult sampling could be relied upon fully for assessing trends of populations.

Dr. Silver pointed out that an accurate assessment of the insect population must be related to degree of damage sustained by the host tree for reliable evaluations. He stressed the need for more basic research of trees and their ability to recover from various intensities of damage before decisions for or against control can be entirely reliable.

Dr. Silver concluded his presentation in summary form, as follows: "In nearly all methods of evaluating infestations there are 2 considerations, (1) the intensity of damage to host trees and (2) an estimate of expected damage by assessment of the insect population." It was pointed out that present methods for biological evaluations are not wholly reliable but that methods now used provided concrete answers in many cases. Much additional research is needed on biology and ecology of the insects and on host trees, however, before all evaluations can be fully reliable.

Dr. Stark discussed methods needed to improve biological evaluations by saying at the onset that the basic needs are, "more research to develop more refined methods of sampling and damage assessment for more forest insects." Dr. Stark then proceeded to discuss specific areas of research which he believed would be most-fruitful. His summary remarks on the general area of study where improvement in evaluations can be made, are as follows:

1. Attitude towards evaluation. There has developed in many areas of forest entomology a complacent or negative attitude in insect control. This leads to a "willy-nilly" type of control where any new insecticide is seized upon and used. The ultimate achievement of real control of insect outbreaks can only be achieved if we maintain an optimistic attitude; seeking always to improve on present methods of control rather than to continue unproductive programs because they apparently satisfy short-term and political requirements.

2. Statement of objectives. Clear objectives are necessary if any research program is to be productive. We should not be satisfied with a program, whether it is a survey or intensive research, unless the objectives go beyond the present boundary of knowledge. In particular, a control program should not be conducted with only an expedient objective in mind, but should be designed to include objectives which will aid in future control studies. This would include new and better sampling methods and better knowledge of the effects of the control method on the whole ecosystem.

Related to the statement of objectives and conduct of control programs is a clear understanding of an insect population, its relationship with the host and methods of expression. These can all be improved upon, usually within the scope of present studies.

3. Utilization of existing facilities. It is always a temptation to continue with "tried and true" methods but in the field of sampling, significant advances are continually being made. Adaptation of new, more refined, methods of sampling to specific problems is not being done to the possible limits. Nor is the available advice being utilized. Biometricians and statisticians are within easy reach of most of us and their cooperation should be solicited in difficult problems - rather than maintaining autonomy at the price of inadequate or inferior methods. Often the basic principles of sampling are not adhered to, either through lack of understanding or the misconception that they would be impractical.

4. Full exploitation of time and money expended. Many of the surveys, intensive sampling and control measures are not fully exploited for the data they can yield. With little or no additional expenditure of time and effort, in such programs data can be gathered to yield more refined, rapid and accurate sampling

methods and/or population expression, leading to better criteria for control. This should be included in the objectives. Furthermore much of the data accumulated in such programs is not fully exploited. Existing data can often be used in designing new sampling methods or in improving present ones. This data may come from a source outside your own particular field (seed production, some crop and other silvicultural studies may be used in preliminary sampling designs for cone and seed insects; mensurational data for bark beetle sampling studies, cultural control and many others).

5. Extension of existing ecological knowledge. Although sampling is fundamental to evaluation methods, we cannot ignore the ecological aspects. We are missing many fine opportunities of studying the insect ecosystem under stress when we aim only at immediate and total control. Although it is obviously impractical in many instances, there should be an attempt, when an insect outbreak occurs, to study a portion of that outbreak from the ecological viewpoint. This has been done in a few instances and has yielded tremendous dividends, e.g., the spruce budworm in eastern Canada and the gypsy moth in eastern United States.

6. A widening of our concept of control. The word control conjures up different images in different minds. We could all benefit by broadening our thinking to include all the possible means of control. Agricultural entomology has demonstrated that integrated control - biological, chemical and possibly cultural - is feasible. In forest entomology we have a few examples of cultural control and the principle is generally recognized. What we need is a greater emphasis in our studies on the possibilities of combination of controls.

7. Post-control evaluation. The importance of pre-control studies as an aid in reaching control decisions has been elaborated on at some length. Post-control evaluation is of equal importance as it should tell you whether the decision reached was a sound one. The first question, of course, is whether the control was successful. The same criteria or methods used in evaluating the outbreak should be used in assessing the results of the control method. This further emphasizes the importance of an ecological study of a similar area in which control measures were not attempted. Without this, there remains in many cases an element of doubt because the natural course of the outbreak or insect population can only be guessed.

Post-control evaluation does not end with a count of the insects killed. It has be be extended to associated insects - the ecosystem, and to successive generations. Often this is not done.

IV. OTHER CRITERIA BEARING ON CONTROL DECISIONS

March 10, 10:00 - 12:00

Discussion Leader: Homer Hartman
Aided by: Paul Grossenbach
Bill McCambridge
Jack Whiteside

When biological evaluation indicate a need for action, there are still other criteria needed to reach a decision for or against control.

The following is a summary of the criteria discussed by the panel:

1. Can the outbreak be controlled?
2. Cost-benefit ratio.
3. Ill side effects - fish, wildlife, etc.
4. Cause of the outbreak - weather, fire, wind, etc.
5. Soil erosion that may result.
6. Age of stand - Can't store tree on the stump forever.
7. Land ownership pattern.
8. Use to which land is being placed - recreation, municipal watershed, growing timber.
9. May protect timber stand from insects while it is being lost to such diseases as white pine blister rust, commandra blister rust or dwarf-mistletoes, etc.
10. Potential damage to adjoining stands and other land ownerships.
11. Stand density and composition.
12. In the case of insect infested plantations - Is the plantation offsite, poor seed source, exotic?
13. Public relations.
14. Is there another way out?
15. Objective of control action.
16. Prevention elsewhere may be better than direct control.
17. Is outbreak too large to control - physically and financially?
18. Effect on dependent communities.
19. Public safety.
20. Logging road access to infested stand.
21. Is full financial cooperation assured by all landowners involved? - Availability of funds.
22. History of previous similar outbreaks.
23. Exactly what is the long term and short term loss?
24. Will control action results be long or short lived?
25. Priority of insect infestation areas and insects.
26. Market for insect infested material.
27. Forest fire hazard being created.
28. Can effective future quarantines be established?
29. Absence or presence of natural barriers.

V. WHAT CONTROL BENEFITS ARE WE OBTAINING FROM PRESENT PRACTICES?

March 10, 1:30 - 3:00 p.m.

Discussion Leader Noel Wygant
Aided by: George Hopping
John Pierce
Galen Trostle

Panel members:

1. The "hit them while they are small theory."
   George Hopping

2. Effectiveness of "maintenance control."
   John Pierce (Presented by Thomas H. Harris)

3. Effectiveness of all-out attack.
   Galen Trostle

Wygant: The panel members will each define their concept of their assigned topic, point out weak and strong points in its theory and application, discuss relationship to surveys, and give examples of control projects in which the practice was used and the benefits obtained from the operation.

Hopping: Long experience and many studies indicate that basic causes of outbreaks are operative over considerable area or an entire region. This is true for both bark beetles and defoliators. Many outbreaks appear to start at an epicenter and spread outward, but this may be an illusion.

For example: An outbreak of the mountain pine beetle started in 1930 in lodgepole pine in the Kootenay Valley that appeared to be an epicenter. Red tops appeared at the southern end of the valley, and the outbreak appeared to progress northward until it reached a young stand 60 to 70 years old. Here it petered out after having killed some of the dominants: The outbreak then developed in mature spruce stands farther up the valley. The speaker's contention is that all the mature stands in the valley were preconditioned for the outbreak by drought.

Another example: In the Bow Valley an outbreak of the mountain pine beetle started about 1940 with no evidence of an epicenter. By 1941 the infestation was 0.6 to 3.4 new trees per acre, an increase of 200 percent. Control work commenced in 1941 and continued through winter of 1943-44. Thirty thousand trees were treated on 15,000 acres. The speaker contends that if control had been delayed one year, 100,000 trees would have to be treated, if delayed two years it would have been beyond control.

The Kootenay Valley was more pleasing to the tourist before the outbreak. A scattered spruce stand developed from release of the lodgepole, and the dead pine adjacent to the highway was salvaged.

On the other hand, the Bow Valley has several large tourist centers, and the control was fully justified.

Bark beetle outbreaks should be hit in their early stages and not necessarily when small in area. In general, an outbreak in an extensive lodgepole pine area with more than 5 trees per acre should not be considered for control -- salvage would be better. Maintenance control is usually necessary following control projects for as long as the environment is favorable to the beetle.

Timing of control for defoliators is different from bark beetles. Some defoliator outbreaks appear to develop from an epicenter, but this may too be an illusion. You can afford to wait the buildup of an outbreak until tree-killing starts. This has the advantage in that natural control factors may intervene before the tree-killing stage is reached. The longer you wait in the outbreak cycle, the lesser the time until natural factors take over.

Urgently needed is more research on the ecological factors governing populations. We cannot afford to make control decisions without this knowledge.

<u>Harris (for Pierce)</u>: Maintenance control removes the forest insect control job from the emergency or special project type to a routine. Maintenance control is limited to high-value forests and is applied continuously to the same area for a long period of time in a situation which is not epidemic. The objective is to prevent outbreaks by continuously controlling potential centers. Points favoring maintenance control are:

1. Forest manager becomes experienced in recognizing and dealing with insect problems.

2. Has valuable public relations aspects.

3. Results in continuous surveillance of the forest.

Some possible weaknesses of problems of the system are:

1. Relatively expensive and no way of measuring results.

2. A great amount of hand labor.

3. Often used as a "fill-in" job for forest manager and incomplete work may result.

A maintenance control program against bark beetles was started at Lake Arrowhead, San Bernardino National Forest in 1921. Records are accurate only from 1939. During this time one epidemic developed in 1940 when 570 trees were infested; another in 1953 when 2,054 infested trees were spotted on 26,740 acres. Since that time, 618 to 866 trees have been spotted and treated annually. It

is believed that this level of control has stabilized bark beetle losses and prevented outbreaks.

Another example of maintenance control is the California flat-headed borer project (in a highly used recreational area) in Laguna Mountains near San Diego starting in 1957. In 1957, 478 trees were treated on 1,500 acres. While there was also a decline in the infestation in untreated areas in 1959, there was an obvious difference between treated and untreated areas.

Trostle: The "all-out" implies large-scale projects. With defoliating insects this means waiting until the tree-killing stage approaches and the damage is no longer tolerable. The same principle is not as workable for bark beetle control because of the large amount of manpower and supervision required in a short season.

Some points in its favor for defoliator control are: (1) danger of reinfestation is less, (2) natural factors may take over and no direct control needed, (3) public supports control for large and spectacular outbreaks, and (4) no need to find epicenters if such exist. Some points against the concept are: (1) large expenditure of funds, (2) high loss of forest resources, (3) danger of incomplete job because of weather, manpower, insufficient finances, etc., (4) coordination with many forest owners.

An "all-out" attack is especially applicable to eradication of a foreign pest.

Examples of "all-out" projects are:

(1) Tussock moth control 1948, northern Idaho. Control was excellent, some tree mortality. Results were reliably determined but infestation declined on untreated areas.

(2) California tussock moth 1956. Good results, good measurements on tree mortality, no check and no indication of decline.

(3) PNW spruce budworm project. Good control, good measurement of results, good precontrol surveys.

(4) Mountain pine beetle in Big Hole Basin. Poor results, poor measurements, no overall survey, no indication when outbreak was over.

(5) Black Hills beetle, Dixie N.F. Unknown benefits, no attempt to evaluate except the number of trees treated each year.

(6) Mountain pine beetle, Tanghee-Teton project. Unknown results, past records of treatment are only criteria.

Conclusions: The effectiveness of an "all-out" program for defoliation control is readily and accurately measured by the amount of defoliation. The stand is affected uniformly. The effectiveness of "all-out" bark

beetle control usually is carried out as maintenance control several years after the main project. The size of an "all-out" bark beetle project is often limited by manpower.

Improvements: Better assessments needed to obtain proper finances and adequate manpower. Better measurements of control results are needed. Need to know timber resources to evaluate losses.

VI. CAN CONTROL BENEFITS BE INCREASED?

March 10, 3:15 - 5:00

Ralph Hall
Walt Cole
Cal Massey

Our panel has been assigned the job of developing the theme, "Can control benefits be increased through the integration of direct control and management methods and integration of chemical and biological methods."

At the very start it might be well to define what we mean by integrated control. Stern et al., 1959, defines integrated control as "Applied pest control which combines and integrates biological and chemical control." I propose a broader definition which might be expressed in the modification of the environment through the use of two or more factors which act directly or indirectly in the reduction of insect pest populations, and resultant damage to timber or timber products.

There are two main ingredients in conditions leading to outbreaks of forest insects. These are (1) biological factors favoring development of high populations of insects, and (2) the quantity and quality of suitable host material.

Walt Cole and Cal Massey are going to cover the integration of chemical and biological factors in increasing control benefit, and I will try to cover some of the aspects of cultural or management practices. Our management methods generally are of a preventive nature rather than curative, and our aim is to modify the environmental factors so that conditions become unfavorable for rapid population increases.

The application of indirect control methods through management requires that we have a thorough knowledge of not only the behavior of the insect, but also the ecology of the host. Some general principles have already been established in the susceptibility of trees or stands to attack and damage by forest insects. In general pure, even-aged stands are more susceptible to damage from various types of insects than are mixed stands. Age, vigor, and competition all are important factors and frequently the forester can change some of these through management method so as to make conditions less favorable for successful insect development.

The big advantages in management techniques is that they are usually effective over a much longer period of time than chemical control methods or other control methods designed to reduce population directly and which do nothing to change the basic environmental factors of stand or tree resistance.

One of the most outstanding examples of modifying the environment in the indirect control of a forest insect is sanitation-salvage logging, which was developed in California by Salman and Bongberg. The principal used here is the removal of the ponderosa and Jeffrey pine trees highly susceptible to attack by the western pine bettle Jeffrey pine beetle and the California flatheaded borer. This method then leaves a relatively healthy stand of timber with a high degree of resistance to bark beetle attack. This method is not a complete panacea with the elimination of all loss but it does reduce losses for at least a 20-year period by about 75 percent. This method has been time-tested and has been standard cutting practice in eastside stands of California for more than a decade. Sanitation-salvage has also been tried, but with less success, in the mixed conifer types in the westside Sierras. One reason for it not being so successful in the westside may be due to a different insect complex.

We have been using sanitation-salvage in integrated control in southern California for several years. In these high-use recreational areas the management objectives are to tolerate no loss from insects. We therefore use sanitation-salvage as the initial control tool and then follow this with direct maintenance control through the salvage of infested trees whenever practical, or if this is not feasible control is carried on through the use of chemicals or by burning. Our experience in this program is that we can now afford maximum protection from bark beetles at a minimum cost. In some cases the sale of the salvaged infested trees more than offsets the cost of additional direct control.

I would like to point out that a forester needs to be on his toes all the time if he is to get maximum benefits out of his management methods. For example, an area may be treated by sanitation-salvage where all of high-risk trees are removed and then along comes an intensive lightning storm where a high percentage of his reserve trees are struck by lightning. This means that he may be right back where he started because now he has a stand with the high-risk element right back in it in the matter of a very short time. If he does nothing to remove these lightning-struck trees, he will not achieve his initial objective.

Another field in which we have made progress in California is in the use of resistant species in our regeneration program. We have demonstrated in the laboratory and in field tests that the backcross hybrid of Jeffrey and Coulter pine showed marked resistance to pine reproduction weevil attack over a ten-year period. Under equal exposure and chance of attack 7 times as many

Jeffrey pines as hybrids were killed. This hybrid is now being propagated on a wide scale, and within a few years will be used in a practical way in regenerating areas where weevil damage is expected to be severe.

The elements and man frequently create situations favorable for the rapid buildup of bark beetles and wood-borer populations. Some of the favorable situations resulting from such factors include blowdown and top breakage, trees injured by lightning, trees injured by fire, and slash resulting from logging, road construction, and land clearing.

The forester can then step in with management practices designed to reduce the quantity or quality of the favorable host material and thereby prevent a potential outbreak in developing. One of the most effective tools in reducing the quantity of favorable food supply is the prompt salvage of windfall, lightning struck strees, or trees killed or damaged by fire. Frequently salvage will not solve the total problem and integration of other methods may be necessary. A case in point is the current situation on over one-thousand forest fire areas in California where an estimated 851 million board feet of merchantable timber was killed in 1959. So far less than half of this has been salvaged, and consideration is being given to the possibility of cutting and decking the material from the most critical areas and treating the decks with chemicals to control the insects already within the tree or preventing attack on the uninfested material.

An example of the reduction of the quality of food material or changing its composition so as to make it less suitable for buildup of _Ips_ problems is the lopping of ponderosa pine slash where as much as 75 percent reduction in population buildup is possible. Still another method in preventing attack by certain wood borers and ambrosia beetles is through the use of sprinklers, or log decks stored on land during the summer months.

Another method of reducing the hazard from buildup of _Ips_ bark beetles in slash is through the timing of cuttings during the late summer and winter when the slash material is a less suitable host material.

We have hardly scratched the surface in the field of management for the solution of many of our insect problems. We might speculate on some future possibilities. We are gradually changing our management from one dealing with virgin stands to those of second growth. Already we can see the handwriting on the wall for some of the problems we are likely to face. We are seeing numerous examples of problems of bark beetles in our second-growth stands that we did not have in the virgin forests, particularly the mountain pine beetle in sugar and ponderosa pine and the fir engraver in white and red fir. We need a great deal more information on the ecology of these second-growth stands

before we can hope to come up with a solution, but there are certainly indications that competition for space, moisture and nutrients may be very important and suggests the possibility of correcting this problem with some system of thinning.

One of our major problems in regeneration in California is loss in cones and seeds from insects. Herb Ruckes found in his study of the sugar pine cone beetles that there seemed to be a strong correlation between the amount of sunlight reaching the ground and damage to cones by this beetle. Whenever an abortive cone on the ground was exposed to full sunlight the mortality to the cone beetle was very high. He has suggested the possibility of controlling this insect through the removal of brush cover to permit the sun reaching the aborted cones. He has also suggested integrating the brush removal with the collection and destruction of aborted cones.

More and more attention is being given to the establishing of seed orchards for the production of forest tree seeds. Here again, certain cultural methods might be applied to reduce damage from insects. One might be the establishment of these seed orchards outside the natural range of our most destructive seed and cone insects. Another possibility of reducing overall damage to cones and seeds in orchards might be through the use of fertilizers to increase cone production, combined with sanitation measures, where all the cones harboring insects are removed from the tree or ground and destroyed.

These are just a few examples of how control benefits can be increased through cultural and management methods. I am sure you can all think of other and better examples, and we would like to hear from you during the discussion period.

The Integration of Chemical Control

Walter E. Cole

Introduction

It is evident from the review of literature that the possibility of integrated control methods is not universally accepted. D. A. Chant (1956) remarked of the attitude in England as, "Those...striving for a sane balance between the use of biological and chemical control...are frequently regarded as deranged but somewhat amusing."

Regardless of attitudes which may be expressed here, continuous, large-scale chemical control programs in forest entomology will bring biological control to the front. It is common sense that as we progress towards the elimination of any species from its environment with the use of insecticides, we are simultaneously violating the elementary principles of natural control. As we destroy the host so also are we destroying some of its biotic control agents.

Definition: Stern (1959) defines integrated control as "applied pest control which combines and integrates biological and chemical control. Integrated control may make use of naturally occurring biological control as well as biological control affected by manipulated or introduced biotic agents."

When applicable: Epidemics occur when ecological conditions are most favorable to the pest insect. When these epidemics have reached the point of sufficient importance, measured by cost and detrimental effect, then direct control should be applied.

Chemical control should embrace the fundamental concept of reduction in population (not elimination), thereby easing the pressures and allowing natural control factors to come into their regulatory roles.

The immediate objective of integrated control should be a complementary, mutually compatible program of chemical and biological control.

The Insecticide

Problems of use: Stern (1959) lists these problems arising from the use of insecticides:

"1. Arthropod resistance to insecticides.

"2. Secondary outbreaks of arthopods other than these against which control was originally directed.

"3. Rapid resurgence of treated species necessitating repetitious insecticide application.

"4. The toxic insecticide residues on food and forage crops.

"5. Hazards to handlers.

"6. Legal complications."

In many cases resistance has been drastic enough to eliminate the use of certain insecticides. Secondary outbreaks usually occur from the interference of the insecticide with biological control. The one closest to home is the spruce spider mite problem in Montana. In this case, the relation between the spruce spider mite and its predaceous mite was disturbed by aerial spraying for the control of spruce budworm. The expected climatic conditions conducive to mite population development were, or had been absent.

Restrictions and adversities: Chemical control programs are limited to the available material. These materials or insecticides are neither reproductive nor persistant, possess no power of search, and usually are of short duration.

Chemical control can neither permanently change the situation nor restrict the future increase of the population without repeated

application. Even the inert residues are capable of toxic and repellent action.

The effect on the entomophagous insects alone can result from either direct toxicity or through starvation by destruction of the host species.

Selective insecticides: When chemical control has been proven necessary, then what?

In order to integrate control measures, selection of the insecticide should be on either a physiological- or ecological-effect basis.

Selectiveness may be accomplished in the ways suggested by Stern (1959):

1. Use an insecticide that is selective in its toxicological action.

2. Produce a selective action.

3. Proper timing.

4. Use a non-selective material with a short-term residual action.

The first way would limit the choice of insecticide to those with a narrow range of toxicity, demand a selective manner of application, and invoke the possibility of low dosage (less direct mortality and greater biological control) versus high dosage (elimination of pest species).

A selective action could be produced by treating only areas lacking in biological control factors. For example, in bark beetle control select trees containing few or no parasites and predators;in defoliator control, aerial spraying particularly, delineate areas badly in need of control. Herein lies a real need for more refined biological evaluation techniques and prediction methods. For without these, the production of selective action could result in greater harm to the ecosystem than if total chemical control was done originally.

This needed knowledge follows in point 3--proper timing. Again intimate knowledge of both host and parasite-predator complex is needed.

Material with short-term residual action might be used if the beneficial insects could survive through proper timing, i.e., if these insects are in a resistant stage, or, as in point 2, in a reservoir-type area.

Chant (1956) suggests the testing of a wide variety of insecticides under either or both laboratory and field conditions in planning a chemical program that will allow the biotic control factors to aid in the reduction of the pest species.

Results from testing under laboratory conditions will allow the most intelligent choice, but, of course, the artificiality is its main drawback. Field testing of chemicals, either singly or in combination; overcomes this handicap, but the results are difficult to interpret.

The ideal selective insecticide. The necessity of using insecticides against insect outbreaks not having efficient biotic agents is generally accepted. This, however, is no reason why we must continue the use of our favorite standby or indiscriminantly choose a newer, more potent insecticide. The choice of the insecticide should be made on the basis of its overall effect against the pest, its natural enemies, or, in short, the ecosystem and not on the pest alone. This could mean the use of an insecticide that is considerably less effective than the best one known for the control of a particular species. One which would have less effect on the other organisms involved would be the better insecticide.

To quote Stern (1959), "The ideal selective material is not one that eliminates all individuals of the pest species...one that shifts the balance back in favor of the natural enemies."

The Integration

Before an integrated program can be attempted there arises a need for intricate planning in coordinating the chemical and biological control factors.

Requirements for coordination. Dowden (1952) lists these four, self-explanatory requirements:

"1. An estimate of the insect's abundance.

"2. An evaluation of the principal natural control factors in operation.

"3. A decision as to when and where to apply chemical control measures.

"4. A choice regarding the best control measures for a particular project."

Success of integrated control. Successful integrated control will be attained when population levels can be ecologically defined, rapid sampling methods devised and selective insecticides developed

(Stern, 1959).

Success will depend on reducing and holding insect populations below the level of economic concern, rather than through elimination of the insect. If chemical control decimates the biotic agents, without eliminating the pest host, then the age-old repetitious treatments are in command. Chemical control should allow these biotic agents to again, or for the first time, become regulatory control factors.

Integrated chemical control has been successful in appropriate situations which leave no doubt as to its great advantages. However, it will not accomplish its purpose if the biotic agents are inadequate, or if the economic level of concern does not warrant such integration with the biotic agents.

This integration, like the early beliefs and hopes for DDT, is not a cure-all. Too much basic ecological knowledge is lacking to immediately, or even within the near future, obtain this paradisaic ultimate in insect control.

The Future of Integrated Control

Integrated control can never be operable or produce the appropriate effect without a knowledge of the principles underlying the fluctuations in the populations concerned.

Research in insect abundance. Insect abundance is controlled by a web of ecological interrelations and the importance of any one factor varies according to other factors that are concurrently active (Glen, 1954).

These factors affecting insect abundance should lead us back to ecology in forest entomology. Insect populations are probably the most unstable components in any ecological system. Eventually simultaneous sampling methods must be devised to encompass many, if not the majority, of these factors.

Methods of measuring population in research studies are usually too intricate and time-consuming for practical application. Thus the need for simple, usable index methods for obtaining indications of population levels and futue trend, followed by precise biological evaluations.

Lines of investigation. Glen (1954) suggests these three immediate routes toward integrated control:

"1. Determination of degree of biological control attainable in complete absence of treatment.

"2. Manipulation of pest control treatment to preserve reservoirs of biotic agents.

"3. Determination of specificity of chemical to the natural enemies."

I would add the following:

1. Define significant insect population levels (pest and enemies of the pest).

2. Develop more accurate prediction methods--particularly for the insect that possesses the occasional but destructive outbreak qualities.

3. Define tolerance levels of insect-caused damage.

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VII SUMMATION OF IDEAS

(On Criteria for Control Decision)

March 11, 9:00 - 10:00 a.m. R. L. Furniss

We have spent two days profitably discussing the conference topic Criteria for Control Decision. Now our job, all of us here this morning, is distill the discussion and answer the question, "Where do we go from here?" As I see it, we should

1. Define precisely where we are now.
2. Chart a course of action by indicating some of the principal problems we must solve to improve the effectiveness of our control methods.

Our order of business in the hour allotted to us will be:

1. I will start by giving my ideas of what has come from our deliberations.
2. Our discussion leaders, whom you all know by now, will sharpen the picture as they see it.

3. Then, by general discussion, we all will try to hammer out a course to work toward, taking into account local problems and conditions.

My summation is aimed at answering three main questions:

1. What evaluation is required?
2. What is satisfactory control?
3. How can satisfactory control be attained?

1. What evaluation is required:
Evaluation should be of a kind and amount sufficient to determine accurately when and what control is needed to meet the objectives of management; and, equally important, to determine when control is not necessary.

Essentially there are two types of evaluation: (A) entomological or biological and (B) administrative, largely economic.

A. Entomological or biological evaluation

Evaluations of this kind are accomplished by surveys of two broad categories (1) damage to host tree and (2) insect population.

(1) Damage surveys. These surveys provide an indirect measure of insect populations of varying accuracy; with bark beetles they usually lag one generation behind the insect. Damage surveys still are basic to the detection survey program in the United States. Often they are heavily depended upon in deciding for or against control. They are useful in determining epidemic trends and cycles. They are especially useful in determining the economic need for control. The methods usually are empirical and heavily dependent upon the judgement and experience of survey personnel.

Our feeling evidently is that damage surveys should be de-emphasized. I hope and believe they will not be eliminated. I urge, too, that the experienced observer not be underrated, for he still contributes much of value to the survey and research programs, even though his observations are not precise.

(2) <u>Insect population surveys.</u> Here again we have a dichotomous breakdown, measurements being of two types: (a) insect density and (b) biological and environmental control factors. We recognize that it is desirable that population surveys be a synthesis of both types of measurement. This need is pointed up by experience with such insects as the western pine beetle indicating that population counts alone are a hazardous basis for forcasting purposes.

Present emphasis is on measurement of insect abundance, sometimes in relation to damage, as with the spruce budworm. We have developed some apparently reliable methods for such insects as spruce budworm, lodgepole needle miner, larch sawfly, Engelmann spruce beetle, and Black Hills beetle.

We are also attempting to measure the status of natural control factors, but so far such measurements have not become established survey procedure, nor have they played much of a part in control recommendations.

The big need in entomological evaluation is defined by Ron Stark as "More research on more refined methods of evaluating population dynamics of more forest insects." He goes on to say that we are not fully utilizing the best survey techniques available, nor are we doing all we should to develop better techniques. He points out specific ways to develop better survey methods.

In capsule, our conference sizeup of the status of entomological or biological evaluation is:

1. We have reasonably reliable methods for some insects but not for others.

2. The best available methods are not now being fully utilized.

3. Methods can and should be improved and extended to more species.

2. <u>What is satisfactory control?</u>

We define satisfactory control variously. Jim Kinghorn sized it up as being "When the land manager ceases to scream for help". He also gave another definition, "It is when the threat to the resource is no longer present, or when it is reduced to a minimum". This is a handy definition and probably is as good as any. Its shortcoming is that our ideas of the threat depends upon our individual management objectives. For example, management objectives and insect control needs differ materially in National Parks, on commercial timber

lands, and on public forest lands.

To be realistic, control needs must be judged in relation to management objectives. This presupposes a stated protection policy; as for example, that of the U. S. National Park Service. In setting up and carrying out control policy, it is essential that it be both biologically and economically sound. We need to be sure that our suppressive action is neither too little nor too much in relation to the benefits received. Expressed another way, the cost-benefit ratio must be favorable.

Noel Wygant suggested as a basis of determining control success, a formal statement of control intention similar to the declaration of surgeons prior to operating. Wygant also suggested a statement of control accomplishment. One of the problems in carrying out this suggestion is the difficulty of measuring control results in terms of timber saved, for who can say with certainty what would have happened had control not been undertaken.

In summary, our conference finds that major needs in determining satisfactory control are to:

1. Define control objectives based upon stated management policy.

2. Develop reliable criteria for measuring the benefits of control.

3. Apply these criteria to actual control projects.

3. <u>How can satisfactory control be attained?</u>

First, an effective and biologically sound method of control must be available for the insect to be controlled.

Second, objectives and scope of control must be defined.

Third, project plans to meet the control objectives must be carefully developed.

Fourth, control operations must be thoroughly carried out.

Good progress is being made in solving most operational problems as they develop. One problem requiring recurrent attention is the conflict between project "efficiency" and "biological necessity". The real biological needs must be met, but the biologist must have evidence that the needs are real and he must help the administrator to be efficient when possible. Of course, there is no room for efficiency just for its own sake.

Opportunities for improvement through research are many. Specifically, the field of integrated control needs more attention. Increased emphasis on biological control and preventive control through management practices is warranted.

These are the highlights of our conference, as I see them. Now I'll turn the topic over to our discussion leaders.

MINUTES OF THE FINAL BUSINESS MEETING

March 11, 1960.

The Chairman opened the meeting at 10:15 a.m.

Minutes of the initial business meeting were adopted as read upon a motion by Mr. Johnson and seconded by Dr. Wygant.

Dr. Knight expressed regrets that he had to leave the meeting early, but he suggested that the new executive express appreciation to the local program committee and their assistants for the excellent program and meeting arrangements provided.

Dr. Stark asked Dr. Graham to outline the general ideas for the theme for the next meeting, and then called for discussion from the floor. The topic "The Effect of Insect Damage from Regeneration to the Final Product" was approved by the members on a motion by Dr. Clark and seconded by Mr. N. Johnson. Prior to the motion, discussion between Mr. Cole, Mr. Bongberg, Mr. N. Johnson and Dr. Graham revealed that the topic could include discussion and preservation of loss measurements.

The Chairman announced the appointment of Dr. Hall to the Education Committee.

The meeting then received committee reports. Mr. Cole relinquished Chairmanship of the Ethical Practices Committee to Mr. Bongberg.

Mr. P. C. Johnson reported that a meeting of the Common Names Committee has been held at noon, March 9th. Considerable interest is still apparent in this field, and he considered that appointments would be made later pending consent of prospective members not present. There remains some unfinished business appurtenant to common names proposed by the committee two or three years ago. He appealed to the membership to keep the committee informed as to names requiring approval.

Reporting for the Committee on Indexing of Reports and Publications, Mr Hopping stated that all regions had completed their indices except Portland and Berkeley. The Fort Collins Index is now complete and is being distributed at this meeting.

As Chairman of the Education Committee, Dr. Stark presented a full account of the findings from the committee's questionnaire which was circulated to 800 foresters in the west last year. A summary of the report is to be appended to the proceedings.

Several recommendations for publicizing the report were acted upon as follows:

(1) Moved by Dr. Wilford and seconded by Mr. Lauterbach that the report be submitted to the Journal of Forestry and the Forestry Chronicle for publication. Carried.

(2) A motion by Mr. N. Johnson that the report be mimeographed prior to formal publication received no seconder.

(3) Moved by Dr. Clark, seconded by Dr. Ruckes that the report be presented at the E.S.A. Pacific Branch meeting in Spokane this year. Carried.

(4) Moved by Dr. Hall, seconded by Mr. Sheperd that a summary of the report be presented at the annual meeting of the Society of American Foresters. Carried.

A vote of congratulations to the committee, and particularly to its chairman was unanimously passed after a motion by Mr. P. C. Johnson and seconded by Dr. Wygant.

Mr. R.L. Furniss pointed out that there is now a nine to twelve month delay in publication of papers submitted to the Journal of Forestry, and that some difficulty may arise out of the dual publication proposed. Mr. Washburn, seconded by Mr. Hopping, moved that priority be given to the Journal of Forestry for releasing the Education Committee's report. Carried.

Turning to the subject of Indexing Reports and publications, Mr. Hopping asked how often the indices should be supplemented. Mr. Bongberg expressed the opinion that with the back-log now taken care of, supplements would only be needed every five or ten years. Mr. Washburn pointed out how difficult it had been to index the large accumulation of old material; he urged that the indices be kept current, but that time of preparation be left to the discretion of each research center.

Dr. Hall and Mr. Furniss drew attention to the huge accumulation of old reports at Berkeley and Portland. Mr. Cole suggested that a current release would be a start and would prevent an even greater accumulation. Mr. Shepherd, Dr. Silver, Dr. Hall, and Mr. Demars spoke in favor of annually listing current reports. Accordingly Mr. N. Johnson moved that annual supplements be prepared and included with the insect condition reports. Seconded by Mr. Shepherd. Carried.

The Chairman then observed that there was no longer a need for a committee for indexing reports.

Upon a motion by Mr. Washburn, seconded by Dr. Hall, the meeting approved in principle the inclusion of maps with the insect condition reports.

Reporting for the Nominating Committee, Dr. Wygant presented the following slate of officers:

Chairman - Dr. B. H. Wilford
Secretary-treasurer - Mr. A.E. Landgraf, Jr.
Councilor - Dr. G. E. Struble
Program Chairman 1961 - Dr. R. C. Hall

Calls for nominations from the floor yielded no further nominations. Each nominee in turn was declared elected by acclamation.

Finally, Mr. R.L. Furniss raised the question of the status of the "central triangle" concept for determining meeting locations. The Chairman suggested that the concept be dropped entirely and that meeting locations be left to the discretion of the executive. No objections to this point in principle were heard from the floor.

A recess in the proceeding was observed at noon.

Dr. Stark turned the meeting over to the new executive. Dr. Wilford expressed appreciation to the outgoing executive, then adjourned the meeting at 2:00 p.m.

FORESTERS LOOK AT FOREST ENTOMOLOGICAL TRAINING

Report of the Education Committee

The summary and conclusions, with Tables I and II, are incorporated in these proceedings. The report, in its entirety, will appear in an early issue of the Journal of Forestry.

Summary and conclusions.

1. The first obvious conclusion is that practicing foresters take their profession and its improvement seriously. The gratifying response to the mail questionnaire and the detailed manner in which the questions were answered indicates an intense interest in this facet of forestry training. We wish to thank and commend the foresters for their efforts.

2. The need for forest entomological training is reflected in the large number who have encountered or had to deal with entomological problems, a total of 444 as opposed to 53 who have not. Their experiences encompassed almost all fields of forest entomological practices from detection, appraisal, control, silvicultural practices and management to manufactured products, such as furniture.

3. There is little doubt that the majority of foresters in western North America at least, recognize the essential nature of entomological training to the forester. Whether the forester had this training or not, 479 indicated that it be taken, only 20 that it was not necessary or that it was a field too involved for the forester to handle. The majority of those who did not take forest entomology felt that it actually made them less effective as foresters.

   A brief survey of the entomology requirements in those universities and colleges in western North America granting forestry degrees shows a great variation in time and emphasis. It is apparent that the entomology courses offered to foresters probably do not meet the requirements indicated by the foresters themselves as desirable. In fact, it is possible, in the majority of schools, to obtain a forestry degree without any entomological training.

4. The possession of training in forest entomology markedly enchances the qualifications of a forestry job applicant.

5. The various criticisms of course offerings and the specific suggestions for improving courses in forest entomology indicate that forest entomology in general, is not yet recognized (in curricular representation at least), as a scientific discipline. Too often, the course is not taught by a forest entomologist and the emphasis of the course offered is heavily "classical" entomology.

TABLE I

QUESTIONS ASKED AND RESPONSES OF THOSE

FORESTERS WHO HAVE NOT TAKEN FOREST ENTOMOLOGY

Question	Yes	No	
1. If you were advising a student enrolled in forestry, and forest entomology is an elective course, would you advise him to take it?	88	5	
2. Do you feel that not having had the course has made you less effective as a practicing forester?	60	30	
3. Have you ever had to deal with any aspect, from detection to control, of a forest insect problem?	88	5	
4. Do you feel confident that you have a reasonable grasp of real or potential insect problems in your lands?	65	26	
	Highly	Moder-ately	Not very
5. If you were to hire a forester to work in the field under your responsibility, how desirable would you consider his having had some course work in forest entomology?	37	50	6

TABLE II

QUESTIONS ASKED AND RESPONSES OF THOSE

WHO HAVE TAKEN FOREST ENTOMOLOGY

Question	Yes	No
1. Have you ever used this training in your professional work?	360	48
2. If not, is this because:		
a) You have not encountered the problem?	37	9
b) The training was inadequate?	23	8
3. If you were again an undergraduate would you, based on your professional experience, elect a course in forest entomology?	391	15

	Increase Emphasis	Decrease Emphasis	No-Satis-factory
4. Could the course you did take be improved in the fields of:			
(1) Taxonomy and Identification	192	60	156
(2) Control methods and operation?	280	16	112
(3) Discussion of causes, known and unknown, of forest insect fluctuations and outbreaks?	312	13	83
(4) Relationship to silviculture and management	346	4	58

CONSTITUTION

OF

WESTERN FOREST INSECT WORK CONFERENCE

Article I <u>Name</u>

The name of this organization shall be the Western Forest Insect Work Conference.

Article II <u>Objects</u>

The objects of this organization are (1) to advance the science and practice of forest entomology, (2) to provide a medium of exchange of professional though, and (3) to serve as a clearing house for technical information on forest insect problems of the western United States and Canada.

Article III <u>Membership</u>

Membership in this organization shall consist of forest entomologists and others interested in the field of professional forest entomology. Official members shall be those who pay registration fees.

Article IV <u>Officers and Duties</u>

The officers of this organization shall be:

(1) A Chairman to act for a period of two meetings, whose duties shall be to call and preside at meetings and to provide leadership in carrying out other functions of this organization.

(2) An Immediate Past Chairman, who shall assume office immediately upon retiring as chairman without further election; whose duties shall be to fill the chair at any meeting in the absence of the chairman; to act until the election of a new chairman.

(3) A Secretary-Treasurer to act for a period of two meetings whose duties shall be to keep a record of membership, business transacted by the organization, funds collected and disbursed and to send out notices and reports.

(4) An executive committee of six members, consisting of chairman, immediate past chairman, secretary-treasurer, and three counsellors elected from the membership. Terms of office for the three counsellors shall be staggered and for a period of three meetings each. The duties of this Committee shall be to carry out actions authorized by the Conference; to determine the amount of funds needed to finance the organization and to set appropriate registration fees or dues; to authorize expenditures of funds; and to establish policies and procedures for the purpose of carrying out the functions of the organization.

The officers shall be elected at the Annual Meeting. Their periods of office shall begin at the conclusion of the meeting of their election.

The chairman shall have the power to appoint members to fill vacancies on the Executive Committee occurring between meetings. The appointment to stand until the conclusion of the next general meeting.

It is the responsibility of a counsellor, should he be unable to attend an executive meeting, to appoint an alternate to attend the executive meeting and to advise the chairman in writing accordingly. The alternate shall have full voting privileges at the meeting to which he is designated.

Article V <u>Meetings</u>

The objectives of this organization may be reached by the holding of at least an annual conference and such other meetings as the Chairman, with the consent of the Executive Committee may call. The place and date of the annual conference shall be determined by the Executive Committee after considering any action or recommendation of the conference as a whole. The Secretary-Treasurer shall advise members of the date and place of meetings at least three months in advance.

Article VI <u>Proceedings</u>

A record of proceedings of conference shall be maintained and copies provided to members in such form as may be decided as appropriate and feasible by the Executive Committee.

Article VII <u>Amendments</u>

Amendments to the Constitution may be made by a two-thirds vote of the total conference membership attending any annual meeting.

-- As amended at Ogden, Utah
March 11, 1960.

PROJECT LIST, FOREST BIOLOGY LABORATORY

BRITISH COLUMBIA (ZOOLOGY), 1959

Investigator	Project Title
Kinghorn, J.M.	Control of the black-headed budworm. (Code No. VZ-2b)
Ross, D.A.	Investigations on (A) cone and wood-boring Lepidoptera, (B) particularly _Dioryctria_ spp. (Code No. VZ-3)
Condrashoff, S.F.	Douglas-fir needle miner, _Contarinia_ spp. (Diptera:Cecidomyidae). (Code No. VZ-4)
Evans, David	A revision of the genus _Enypia_ (Lepidoptera: Geometridae). (Code No. VZ-6b)
Evans, David	A study of the ecology and associates of an oak-gall wasp, _Besbicus mirabilis_ Kinsey. (Code No. VZ-7)
McMullen, L.H. & M.D. Atkins	General studies of the Douglas-fir beetle, _Dendroctonus pseudotsugae_ Hopk., in the interior of British Columbia. (Code No. VZ-11)
Atkins, M.D.	Flight physiology and behavior of the Douglas-fir beetle, _Dendroctonus pseudotsugae_ Hopk. (Code No. VZ-11a)
Chapman, J.A.	A study of the biology, physiology and behaviour of the ambrosia beetle, _Trypodendron lineatum._ (Code No. VZ-15a)
Dyer, E.D.A.	Factors influencing the abundance and distribution of ambrosia beetles, particularly _Trypodendron lineatum._ (Code No. VZ-16(a))
Kinghorn, J.M.	Control studies of ambrosia beetles. (Code No. VZ-16c)
Hedlin, A.F.	Insects affecting seed production in Douglas-fir. (Code No. VZ-19)
Smith, D.N.	Infestation level of _Anobiidae_ in relation to strength deterioration of structural timbers. (Code No. VZ-21a)
Atkins, M.D.	Studies on the primitive beetle _Priacma serrata_ (Lec.) (Cupedidae: Coleoptera). (Code No. VZ-25)
Condrashoff, S.F.	Bionomics of aspen leaf miner, _Phyllocnistis populiella_ Chamb. (code No. VZ-26)

Harris, J.W.E.	A study of the poplar and willow borer, Sternochetus lapathi L. (Code No. VZ-27)
Harris, J.W.E.	Population sampling of the two-year cycle spruce budworm Choristoneura fumiferana (Clem.). (Code No. VZ-28)
Evans, D.	The life history of Melanolophia imitata Walker, with descriptions of the stages (Lepidoptera: Geometridae). (Code No. VZ-29)
Wellington, W.G.	Investigations in ecological meteorology with special reference to the ecology of forest insects: General studies. (Code No. B-2)
Edwards, D.K.	Influence of atmospheric electricity and pressure on insect behavior and development. (Code No. B-8)

RESEARCH PROJECTS IN OREGON AND WASHINGTON
1960

The following is a list of the current research projects of the Pacific Northwest Forest and Range Experiment Station. This list is from the Line Project Report for the year ending April 30, 1959.

Line Project No.

FS-2-1 11-8-PNW

Line Project Title: Douglas-fir beetle, ecology and control.

Study Objectives: (a) To determine the reasons for periodic outbreaks in the Douglas-fir region, and (b) to determine the rate of deterioration of trees killed by the Douglas-fir beetle.

FS-2-I 14-4-PNW

Line Project Title: Spruce budworm - biology, ecology, and natural control.

Study Objectives: To determine: (a) The distribution of populations on trees and within stands as a basis for extensive sampling, (b) the effects of natural control factors upon population trends, (c) infestation characteristics, such as differential occurrence of damage (d) effects of spraying upon the budworm, its parasites, and associated insects, (e) variations in life history and habits with different tree hosts and environmental conditions.

FS-2-I 14-10-PNW

Line Project Title: Black-headed budworm - biology and control.

Study Objectives: To determine: (a) the distribution of populations on trees and within stands as a basis for extensive sampling; (b) the effects and relative importance of major natural control factors, such as insect parasites and disease; (c) quantitative aspects of the life history and habits, such as rate of development and reproductive capacity; (d) the relation between populations and subsequent defoliation and damage.

FS-2-I 15-4-PNW

Line Project Title: Chermes, a forest insect pest, its biology, ecology and control.

Study Objectives: (a) To determine the biology and seasonal history of the insect on its principal host trees in Oregon and Washington, (b) to catalog the native insect predators of chermes and assess their effectiveness, (c) to import and colonize available foreign predators, and (d) to evaluate tree mortality and damage trends on permanent plots in Pacific silver fir stands.

FS-2-I-unnumbered-PNW

Line Project Title: Sitka spruce weevil - biology, ecology and control.

Study Objectives: (a) To measure and evaluate the importance of the weevil in Sitka spruce stands in Oregon and Washington, and (b) to test resistance of other spruce species and hybrids to the weevil.

FS-2-I 17-2-PNW

Line Project Title: Insect aerial surveys - development of methods.

Study Objectives: To develop and improve aerial techniques and equipment for locating and evaluating insect outbreaks and tree mortality in major timber types of western states.

CURRENT RESEARCH PROJECTS IN FOREST ENTOMOLOGY AT OREGON STATE COLLEGE (1960).

1. Laboratory studies on the relative contact and residual toxicity of promising insecticides to Dendroctonus pseudotsugae Hopk.

2. Field studies on bark penetration and effectiveness of various formulations of promising insecticides upon the insects infesting Douglas-fir logs (in cooperation with Oregon Forest Land Center).

3. Biological and morphological study of the Douglas-fir beetle parasite, Coeloides brunneri Vier.

4. Investigations on the resistance of conifer to bark beetle infestation (in cooperation with Boyce Thompson Institute, Forest Research Laboratory).

5. Influence of phloem moisture in windthrown and cut Douglas-firs on the population dynamics of the Douglas-fir beetle.

6. Influence of the inter- and intraspecific space competition upon the rate of production and the mortality of the Douglas-fir beetle.

7. Mass rearing of the Douglas-fir beetle in the laboratory.

U.S. DEPARTMENT OF AGRICULTURE--FOREST SERVICE

PACIFIC SOUTHWEST FOREST AND RANGE EXPERIMENT STATION

Berkeley 1, California

WORK AND LINE PROJECTS

New No.	Supersedes	Title
FS-2-e1	FS-2-11	BARK BEETLES AFFECTING FOREST & SHADE TREES
FS-2-e1-1	FS-2-11-1 & FS-2-11-2	Studies in the control of pine bark beetles through the classification of trees according to their susceptibility to attack and by the selective logging of susceptible trees from infested stands. Assignment: Eaton, Hall, Struble, Wickman
FS-2-e1-2	FS-2-11-4	Interrelations of fire and insects in pine stands. Assignment: Struble

New No.	Supersedes	Title
FS-2-e1-8	FS-2-11-11; also FS-2-11-12 in part	Resistance of trees to bark beetles. Assignment: Smith
FS-2-e1-9	FS-2-11-13	Studies to develop or improve methods of preventing or controlling miscellaneous bark beetles through the use of toxic oil sprays. Assignment: Bushing, Lyon
FS-2-e1-10	FS-2-11-14	Mountain pine beetle - ecology and control. Assignment: Struble
FS-2-e1-13		Diseases of bark beetles. Assignment: Thomas
FS-2-e3	FS-2-14	DEFOLIATING INSECTS AFFECTING FOREST AND SHADE TREES
FS-2-e3-4 (new)		Needle sheath miner, a pest of young pines. Assignment: Stevens
FS-2-e3-7	FS-2-11-12 (in part); also FS-2-16-6	Resistance of trees to insects other than bark beetles. Assignment: Hall, Smith
FS-2-e3-11	FS-2-14-15	Lodgepole needle miner--biology, ecology, and control. Assignment: Stevens, Struble
FS-2-e4	FS-2-13 FS-2-15 FS-2-16	INSECTS OTHER THAN BARK BEETLES AND DEFOLIATORS AFFECTING FOREST AND SHADE TREES.
FS-2-e4-7	FS-2-16-7	Insects destructive of the flowers, seeds, and cones of trees--biology, ecology, and control. Assignment: Koerber
FS-2-e5	FS-2-17	DEVELOPMENT OF METHODS FOR CONDUCTING FOREST INSECT SURVEYS
FS-2-e5-1	FS-2-17-1	Studies of methods for improving the accuracy and efficiency of forest insect ground surveys. Assignment: DeMars, Hall, Stevens, Wickman
FS-2-e5-2	FS-2-17-2	Studies of methods for conducting forest insect surveys from the air. Assignment: DeMars, Hall, Stevens, Wickman

New No.	Supersedes	Title
FS(Unnumbered)		SURVEYS AND CONTROL OF FOREST INSECT PESTS
	(LP unnumbered)	Conduct and coordination of forest insect surveys in Region 5. Assignment: DeMars, Hall, Stevens, Wickman

CURRENT RESEARCH PROJECTS
Division of Forest Insect Research
Intermountain Forest and Range Experiment Station

Ogden - Boise - Missoula

Line Project Title: Studies in the control of pine bark beetles through the classification of trees according to their susceptibility to attack and by the selective logging of susceptible trees from infested stands.

Study Objectives:

1. To develop or refine tree classification systems that accurately reflect the susceptibility of pine trees to bark beetle attacks.

2. To determine the stability or rate of change of risk classes.

3. To develop effective and economical methods of controlling the insects by the removal and utilization of trees that are most likely to be attacked.

Line Project Title: Diseases of forest insects other than bark beetles.

Study Objectives:

1. To identify the infectuous diseases of important species of forest insects other than bark beetles.

2. To develop methods and techniques for studying these diseases and for propagating and otherwise handling effective ones.

3. To determine the effect of these diseases on their hosts, and the possibilities of artificially establishing them in infested stands where they do not occur naturally.

Line Project Title: Black Hills beetle--biology, ecology, and control.

Study Objectives: To obtain information on Black Hills beetle development and population fluctuations in southern Utah.

Line Project Title: Douglas-fir beetle--biology, ecology, and control.

Study Objectives: To develop a system of sampling populations of Douglas-fir beetle and to study epidemiology of the species.

Line Project Title: Spruce budworm--biology, ecology and natural control.

Study Objectives:

1. To correlate spruce budworm population levels with damage to host tree species, including both growth loss and mortality, and to define damage.

2. To determine factors governing rise and fall of spruce budworm populations, measure the effectiveness of these factors, and develop methods of predicting trends from field-collected population data.

Line Project Title: White fir needle miner--biology, ecology, and control.

Study Objectives: To determine facts on biology and ecology of the white fir needle miner, (*Epinotia meritana* Hein.), and to develop satisfactory direct or indirect methods for its control.

Line Project Title: Sucking insects other than the balsam woolly aphid--biology, ecology and control.

Study Objectives:

1. To determine life history and habits of the spruce mealybug, *Puto* sp.

2. To determine the influence of insect predators or parasites on its abundance.

3. To develop satisfactory direct or indirect methods for its control.

Line Project Title: Studies of methods for improving the accuracy and efficiency of forest insect ground surveys.

Study Objectives:

1. To test the use of mountain pine beetle brood data in determining current infestation trends in lodgepole pine forests.

2. To detect and measure the initial buildup of epidemic spruce budworm populations from measurements of hibernating larval populations.

3. To determine the relationship for low temperature exposures to the length of spruce budworm larval diapause.

4. To determine percent of ultimate defoliation from the emerging budworm larval population.

5. To develop techniques for measuring spruce spider mite in Rocky Mountain Douglas-fir forests.

Line Project Title: The larch casebearer--biology, ecology and control.

Study Objectives:

1. To observe, follow, and record the establishment and spread of the larch casebearer in western larch.

2. To determine the extent of natural control by parasites.

3. To investigate the possibility of introducing one or more species of parasites known to exert effective control of the casebearer in the eastern half of the country.

CURRENT STUDIES

FOREST INSECT RESEARCH

ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

Engelmann spruce beetle - Biology, ecology and control

1. Identification of associated insects.
2. Prediction of infestation trends by sampling of beetle populations.
3. Life history of the beetle in static and declining infestations
4. Insect vigor as measured in terms of egg production.
5. Life history of *Coeloides dendroctoni*.
6. Ecology of predaceous woodpeckers.
7. The effect of spruce cull or host material.
8. The ecology of the beetle in a localized outbreak.
9. Evaluation of systemic insecticides.
10. Improvement of trap trees with chemicals and baits.
11. Improvement of formulation of ethylene dibromide.

Black Hills beetle - Biology, ecology and control

1. Collection and identification of associated insects.
2. Prediction of infestation trends by sampling of beetle populations.
3. Insect vigor as measured in terms of egg production.
4. Determine optimum temperature and relative humidity for beetle development.

Methods for improving the accuracy and efficiency of forest insect ground surveys

1. Comparison of systematic versus random sampling for Black Hills beetle surveys.

2. Development of a method for estimating Douglas-fir beetle infestations.

3. Determine sampling height for evaluating Douglas-fir beetle infestations.

4. Determine sampling method for evaluating mountain pine beetle infestations.

5. Test sampling procedures for evaluating pandora moth infestations.

Methods for conducting forest insect surveys from the air

1. Continue tests of aerial photography in insect surveys.

2. Evaluate aids for aerial observers.

3. Continue tests of the helicopter for detection surveys.

Southwestern, roundheaded and Colorado pine beetles and associated beetles - Biology, ecology and control

1. Life history of *Ips lecontei* in ponderosa pine.

2. Life history of *Aphelenchulus elongatus*, a nematode parasite of *Ips lecontei* and *Ips confusus*.

3. Taxonomic studies on nematode parasites and associates of bark beetles.

4. Life history of the Southwestern pine beetle (*Dendroctonus barberi*).

5. Life history of *Ips confusus* in pinyon pine.

6. Protection of trees from bark beetle attack through the application of residual insecticides.

Diseases of Forest Insects other than bark beetles

1. Control of the Great Basin tent caterpillar with a polyhedrosis virus.

Douglas-fir tussock moth - Biology, ecology, and control

1. Life history of the Douglas-fir tussock moth, *Hemerocampa pseudotsugata.*

2. Natural control of the Douglas-fir tussock moth.

Miscellaneous studies

1. Life history and control of the pinyon pine needle scale (*Matsucoccus acalyptus*).

MEMBERSHIP ROSTER

WESTERN FOREST INSECT WORK CONFERENCE

Note: Active members registered at the conference in Ogden, Utah, March 9-11, 1960, are indicated by an asterisk (*).

REGIONS 1 & 4 USFS (Ogden)

*CAHILL, DONALD B.
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